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Abstract

EXPERIMENTAL STUDY OF FLOW INVERSION IN THE BELGIAN ENGINEERING TEST REACTOR BR2

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After a brief review of the reactor BR2, the Belgian high flux engineering test reactor, the paper describes the tests carried out recently to determine the maximum safe operating power. These tests consisted essentially in the measurement of the temperature of the surface of the fuel elements, using thermocouples imbedded in the cladding, at different reactor powers, and then deliberately inducing all possible fault conditions; these included the total loss of coolant flow (by stopping all main pumps, or by opening a by-pass valve or by closing the main flow valves) and loss of pressure in the primary circuit. Flux measurements were carried out in the core at the same time. The paper describes the organization of the tests and the equipment used.

During the tests, the maximum power attained was 37 MW, giving a maximum heat flux of 600 watts per square centimetre at the fuel element surface. This value is 1.5 times the planned operating figure, and is an exceptionally high value for this type of fuel element.

The corresponding thermal neutron flux (energy above 0.5 eV) in the fuel plates was 10^{15} $n.cm^{-2}.$ sec^{-1}. Even under these extreme conditions provided that pressure was maintained, the sudden loss of coolant followed by a flow inversion in the core did not lead to unacceptably high plate temperatures.

The paper gives an analysis of the results both at steady power and during the different tests, and in particular for the most severe transient.

After determination of the time of the inversion, the maximum "hot-spot" temperatures in the fuel are calculated. The upper limit of specific power is then determined so that boiling does not occur even in the hottest channel.

These data permit the safety assessment of this type of reactor at high specific powers and for different core configurations.